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ALICANTE * 19/20/21/22 SEPTEMBER 2018

CONGRESS PROCEEDINGS

EURAU18 alicante
RETROACTIVE RESEARCH
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ISBN: 978-84-1302-003-7
DOI: 10.14198/EURAU18alicante

Editor: Javier Sánchez Merina
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Titulación de Arquitectura

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From mechanical to digital paradigm

Empirical Methodology

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Synopsis

The new digital tools have become into essential instruments for architecture: they have revolutionized various fields, from graphic representation to conception and including to the development of new ways of transferring knowledge. The current computer tools allow us a more accurate representation of reality and digital manufacturing tools make possible to control the design and production simultaneously. The completion process has a great influence on the result.

Architecture must not avoid the existing reciprocity between the formal intentions and the possibilities of manufacture. The paradigm of the standardization, which it is present during the most of the XXth century, gives way to the digital paradigm present nowadays in the schools of architecture and the Fablab or Digital Laboratories. From an experimental perspective diverse international workshops have been organized, as an strategy to test the validity of the new digital paradigm.

For one week the students are working about deployable structures and they design architectural artefacts using a series of methodologies introduced at the beginning of the seminar. The new digital paradigm allows to produce exclusive prototypes in contrast to the mechanical paradigm that realized products in series. For this reason it becomes necessary to define some useful parameters to relate and compare different characteristics between prototypes, and all these parameters associated with the efficiency of the process.

1. Introduction. From standardization to digitalization process.

“Before the founding of the École des Beaux-Arts in Paris in 1671, the communication between the teacher and the apprentice took place through direct experience in building on site, and theoretical knowledge consolidated on a narrow contact with reality. After the institutionalization of architecture teaching and, as a consequence of the Industrial Revolution that required a massive amount of trained professionals, the traditional relationship between praxis and theory was reversed” (Borrego, 2017).

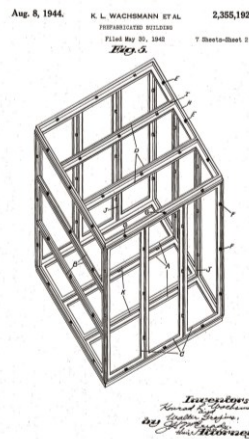


Figure 1. Patent 'Prefabrication Building' from Konrad Wachsmann and Walter Gropius. 1944.

Modern Movement of architecture, in the first decades of 20th Century, was aware about to standardize the prototypes following the metaphor of the machine. The Deutsche Werkbund, to which there belongs many German architects during the above mentioned period, tries to rationalize the constructive process through the industrialization, principally those authors who were in favor of the Typisierung (Frampton, 1987); that process consisted to realize this industrialization work from the standardization of a few types. In the Bauhaus, the school inaugurated by Walter Gropius in 1919, is possible to find new standardization theories being part of the teaching matters and new architects learning about it. Gropius was obsessed about the complete prefabrication of the construction process and he designed, along with Konrad Wachsmann, a series of prefabricated houses as prototype. The result was registered in a patent titled 'Prefabricated' and it is described: “It is the chief object of the invention to devise a building structure which can be assembled exclusively, or substantially so, from standard units or sections, each consisting fundamentally of duplicated of the other, so that they can all be manufactured completely in a factory equipped with machinery for producing them efficiently” (Wachsmann, Gropius, 1944).

Since the introduction of the computers in the studios -from 1992-, the digital processes are habitual for the architectural practice. Nowadays architecture is inconceivable without the use of software like Autocad, Maya or Rhino. The debate is no longer focused on if these tools are optimal resources or not, but how they are changing the architectural process. One of the most important consequences is the possibility of working with complex geometries and the possibility to parameterize designs applying complex algorithms. Also it allows to relate the

design and the production processes. As consequence is already not necessary to standardize the elements to diminish costs and allows the production of the only prototypes and this way: “The crisis of traditional tectonic codes that defined the hierarchy of building parts and its meaning represents another crucial aspect of the contemporary digital architecture scene.” (Picon, 2007).

This individual aspect of the architectural prototype also is described by Nicholas Negroponte in *Being Digital*, where he exposes the individual condition of the digital condition. Negroponte is the creator of the MIT Media Lab (Technological Institute of Massachusetts), a center where the international network named Fab-Lab Network is promoted. This network is pioneering in what it is named the “third digital revolution”. The Fab-labs are laboratories for the investigation and the innovation, as the development of new emergent technologies as the development of its applications. Their investigations focuses on the development of digital software associated to the digital manufacture using the most new tools, as printers 3D and cutters laser that favor the prototypes achievement to scale 1/1.

The new forms of computerized digital manufacture allow to integrate during the design process all the aspects of the constructive process in a complex combination between the abstract geometric definition and the specific realization.

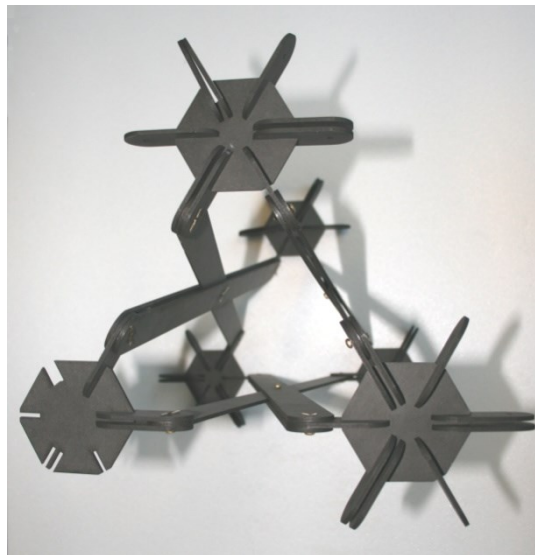


Figure 2. Prototype. Digital Fabrications & Deployable structures Workshop. TU Berlin. 2018.

2. Digital Fabrications & Deployable structures

The seminar ‘Digital Fabrication & Deployable Structures’ is organized with the format of intensive workshop. Thus a limited group of students will have the possibility to transform the theory about folding structures into real prototypes of scale 1:1, designing prototypes related with the idea to colonize a space to be inhabited. Different groups share for one week the same workspace, an studio with tables to work in groups, enough free space to test the different prototypes and the laser cutter for the immediate execution of the designs during the whole process. During the first days we explained to students basic notions of the patents of Emilio Pérez Piñero, Félix Escrig and Charles Hoberman. They could find here different deployable structures options

to choose and to apply for their proposals during the workshop. Also some necessary instructions to use the cutter laser (SABKO Gmb HSH-G1290, 1200mm x 900mm) are explained and in an independent way for every student. They will have badges of MDF dyed black of 3 mm of thickness, in two sizes 1200 x 900mm and 1200mm x 300mm, to design the bars and knots. The joints of the knots will be solved with screws, tweezers or other elements that the student could estimate. Also it is possible to include complementary elements during the design process of the prototype, like textiles materials, tensile, etc. Another day it is planned a brainstorming session, to explain different ideas for the prototypes and possibilities for the designs. After that the groups start the process of test and error building the prototypes or parts of them at the same time that the students are designing: this strategy help to make decisions, to detect problems and to find solutions efficiently, and all of these elements into real scale. This shared experience serves as creative catalyst of solutions in common: all groups can learn of the other students and prototypes. This approach help to observe how the prototypes are evolving and improving in every moment, and always with the necessary technological precision during this process of digital fabrication. The seminar turns into an updated version of the medieval guild studios, where the digital media has substituted the specific tools of craftsman, and the models evolve with the precision of the system of production. Finally each group of students complete 'specific prototypes', which are evaluated by different indicators that in its set help us to quantify the idea of efficiency of every prototype.

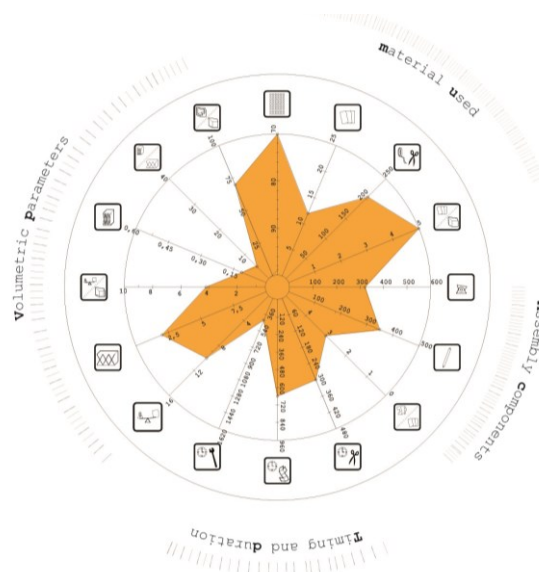


Figure 3. Efficiency ruler. TU Berlin. 2017/2018.

3. Conclusions

The parameters designed allow us to value therefore each prototype opposite to others, since, its direct comparison is not possible because all of them are different. The digitization of the process is what allows the uniqueness of the architectural designs and the prototypes. Parameters as foldable index, duration of the assembly process, duration of the cutting process or superficial module variation are used to verify the efficiency of each 'Specific Prototype'.



Figure 4. Specific Prototype. TU Berlin. 2018.

Considering all the parameters, we generated a multidimensional scale or ruler, endowed with several axes, that allows us to measure the efficiency of the generated prototypes. As a general criterion, one prototype would be more efficient than another, if its diagram, once represented on the aforementioned scale, had a smaller surface area. The results show the validity and possibilities of the digital process: it allows the manufacture of differentiated models, something quite expensive in the previous mechanical paradigm and it allows to realize a comparative analysis between the prototypes using parameters to prove their efficiency. Maybe we are in the beginning of a new period where the educational model of the workshop or seminar is implemented again. Workshops with the idea of making gadgetry that unite the optimization of the process, as the followers of the Typisierung were chasing, and simultaneously to preserve the uniqueness of the designed object, as the followers of the Kunstwollen were chasing in the debate opened in the Deutsche Werkbund 100 years ago. Perhaps, in this period, we are able to reinterpret the possibilities of artisan craftwork from the perspective of the digital paradigm.

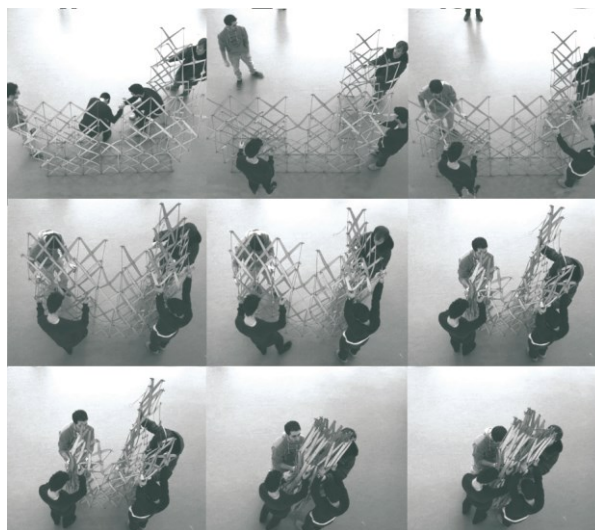


Figure 5. Specific Prototype. TU Berlin. 2018.

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